I P REVIEW

INSTITUTE OF PETROLEUM

Published by The Institute of Petroleum
26 Portland Place, London, W.1

Volume 1. No. 4. April, 1947. Price 2/-. Annual Subscription: One Guinea

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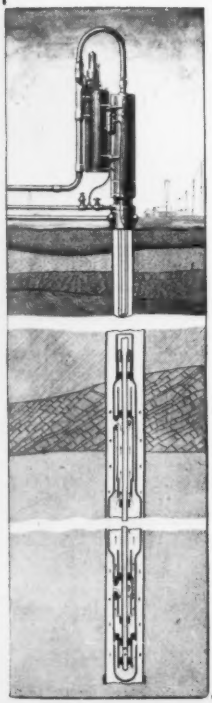

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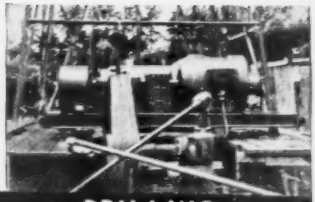

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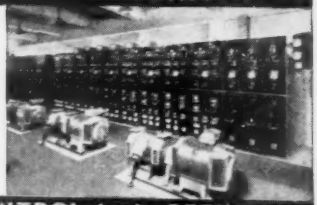

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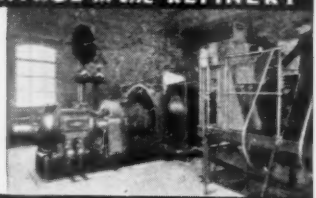

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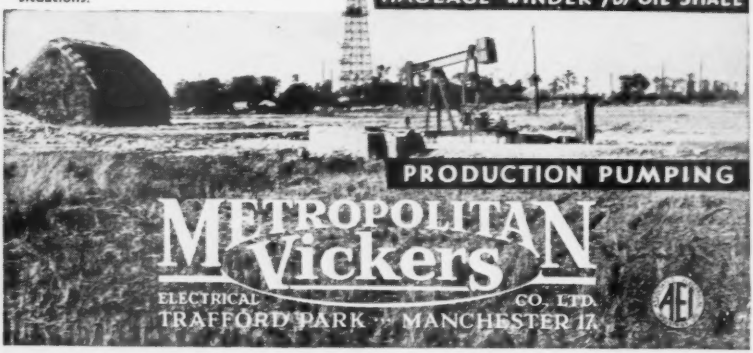

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No. 4 APRIL, 1947 Vol. 1

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SOME AMERICAN THOUGHTS ON TO-MORROW'S OIL*

BY LIEUT.-COLONEL S. J. M. AULD, O.B.E., M.C., D.Sc.
Past President, Institute of Petroleum

PERIODICALLY the United States of America seem to experience some alarm in respect of their reserves of oil and their position as the outstanding producers of the world. In recent years there has again been some apprehension in this matter, but this time they are aware that the alteration of the situation is real. That is the outstanding impression which must be left on an oil man visiting America at the present time. The feeling that something has got to be done to improve the balance of their oil budget is so strong that the U.S. Government has gone the length of instituting a close examination of sources other than petroleum for the augmentation of supplies of liquid hydrocarbon products in case of need.

It can be said at once that American reserves of crude oil are no worse than they have been. The actual proven reserves in the U.S. are well-known and there is no reason to doubt that, as in the past, they will be added to continuously and appreciably from areas known to be oil-bearing but not delimited and from other areas yet to be found.

What has had more effect on forming American lay opinion than anything else, however, has been the much publicized vastly increased oil production from other parts of the world, first of all during the war from South America, especially Venezuela and Colombia, and now from the Middle East. (See Table 1.) At the same

* Address to the Students' Section (London Branch), February 13, 1947.

TABLE I

ESTIMATED WORLD CRUDE OIL PRODUCTION

	1946	1945
	1000 *metric tons*	
United States ..	234,000	231,198
Venezuela ..	54,000	46,368
U.S.S.R. ..	22,400	20,000
Iran ..	19,000	17,109
Saudi Arabia ..	7,000	2,872
Mexico ..	6,700	6,057
Iraq ..	4,470	4,712
Rumania ..	4,300	4,640
Colombia ..	3,300	3,252
Argentina ..	3,100	3,276
Trinidad ..	2,900	3,079
Peru ..	1,800	1,836
Neth. E. Indies ..	1,300	1,359*
Egypt ..	1,200	1,344
Canada ..	1,000	1,100
Bahrein ..	980	980
Kuwait ..	800	—
Hungary ..	700	654
Austria ..	700	445
Germany ..	650	530
Sakhalin ..	550	500
British Borneo ..	500	445*
British India ..	330	360†
Ecuador ..	330	346
Japan ..	230	300
Other countries ..	900	401
Total	373,140	353,163

* Including estimated enemy production prior to liberation.
† Including a small output from Burma.

time American consumption is greatly increasing, very markedly since the war, so that there is a still further tendency, as there has been for a good many years past, for the outstanding position of America as a world supplier of oil relatively to decline.

In order to give you my impressions of American oil activity (and America is still the outstanding leader in production, supply, and utilization of petroleum) it is necessary to examine, somewhat critically, the production position there, to look at the steps being taken to augment it by means other than association and purchase, and finally to consider what they intend doing with the oil they have for disposal.

THE INTERNAL POSITION IN AMERICA

As recently as October 1946, expert estimates of U.S. oil demand and supply were considered by a special Senate Committee. U.S. needs of all oils were put at 5,100,000 barrels a day by 1950, and 5,800,000 by 1965, against 3,900,000 barrels in 1939, and it was considered unlikely that America's output of petroleum could for ever keep pace with such an increase.

At the same time it has been pointed out that the utilization of petroleum in the direction of producing more efficient motor fuels (both gasoline and the heavier distillates required for diesel engines and gas-turbine jet aircraft) has emphasized the fact that there will be a corresponding reduction in the yield of heavy bunker and furnace fuel oils. This increasing switch of petroleum from use as residual heavy fuel to application for the production of lighter products is estimated to result in a decline of the average yield of residual fuel oil from 19 per cent in 1945 to about 10 per cent in 1965, compared with a pre-war figure of around 25 per cent.

For any form of oil self-sufficiency, heavy fuel is essential, particularly for naval and mercantile security, and it has been suggested that the American deficit should primarily be met, therefore, by making good this heavy oil. Whilst choice in favour of importing heavy fuel has certain adverse implications, there is little doubt that the decision is a sound one to import such oils, in the form of crude or otherwise, as will help to bridge the gap between light and heavy products.

It is important to note in this connexion that, both economically and strategically, America will be much better advised, when she does increase oil imports, to import crude oil if possible rather than the distillates or

even residuals, which to-day form a substantial part of her purchases.

AMERICAN ACTION

With this as a premise let us see what action America appears to be taking in the matter. It has been appreciated for some time past that oil imports into the States from South America have been on the increase, but by reason of the expanding national aspirations of South American countries as a whole the control of such production is passing, to an appreciable extent, from American hands as, for example, in Mexico and the Argentine. It is by no means surprising, therefore, that ever since the successful participation in the Iraqian exploitation and particularly during the last few years, the States has turned its attention to the Middle East not only as an oil-producing centre in which it wished to have a financial and distributional share but now as a possible source of raw material for itself; or at any rate as a means of saving or sparing its own production.

In the world pattern of oil occurrence there are four main basins so far discovered (Fig. 1), which are very well defined:

(1) The Caribbean Basin, i.e., the area lying between North and South America, covering the United States deposits as far as the Middle West and going as far south as Mexico, Colombia and Venezuela;

(2) The Mediterranean and Middle East, which includes the Russian deposits of the Caspian and Black Seas and the oilfields of the Persian Gulf. In this area, therefore, lie the great oilfields of Iran, Iraq, Arabia, Rumania and Southern Russia;

(3) The East Indies, i.e., the much smaller, though still important, area lying between Australia and Asia in which are the deposits of Java, Borneo, New Guinea, etc.;

(4) The undeveloped but believed considerable area surrounding the North Pole.

Apart from the fact that the East Indian basin is of much smaller size, and strategically badly placed, the area outside its own borders which is most attractive to the U.S.A. must obviously be that of the Middle East where potential supplies are bigger (Table II) and concessions more untrammelled.

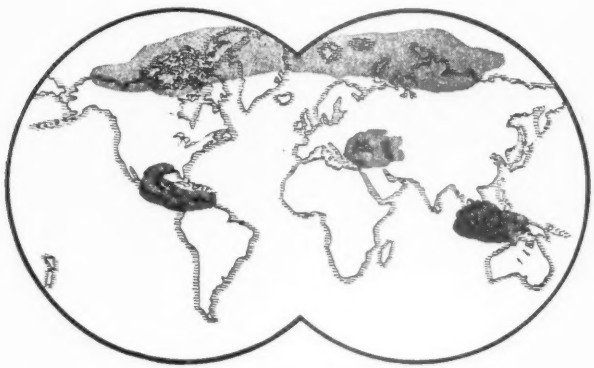


Fig. 1.—The four main basins of oil occurrence

TABLE II

OIL PRODUCTION IN THE MIDDLE EAST

	1938	1946*a*	1951*b*
	1000 *metric tons*		
Iran ..	10,359	19,000	31,000
Saudi Arabia	70	7,000	20,000
Iraq ..	4,364	4,470	13,000
Kuwait ..	—	800	10,000
Bahrein ..	1,137	1,000	1,000
Qatar ..	—	—	2,000
Total	15,930	32,270	77,000

(*a*) Preliminary figures. (*b*) Estimated.

In 1943 the American Government set up the Petroleum Reserves Corporation, a Government-controlled body formed on the recommendation of the fighting services to ensure adequate supplies of oil for the carrying on of the war. By 1944 the P.R.C. announced that an agreement with three American oil companies had been made whereby the P.R.C. would construct, own, and maintain a main trunk pipeline system for the transportation of crude petroleum from the American-owned fields of Saudi Arabia and the shared field of Kuwait to the Mediterranean (Fig. 2).

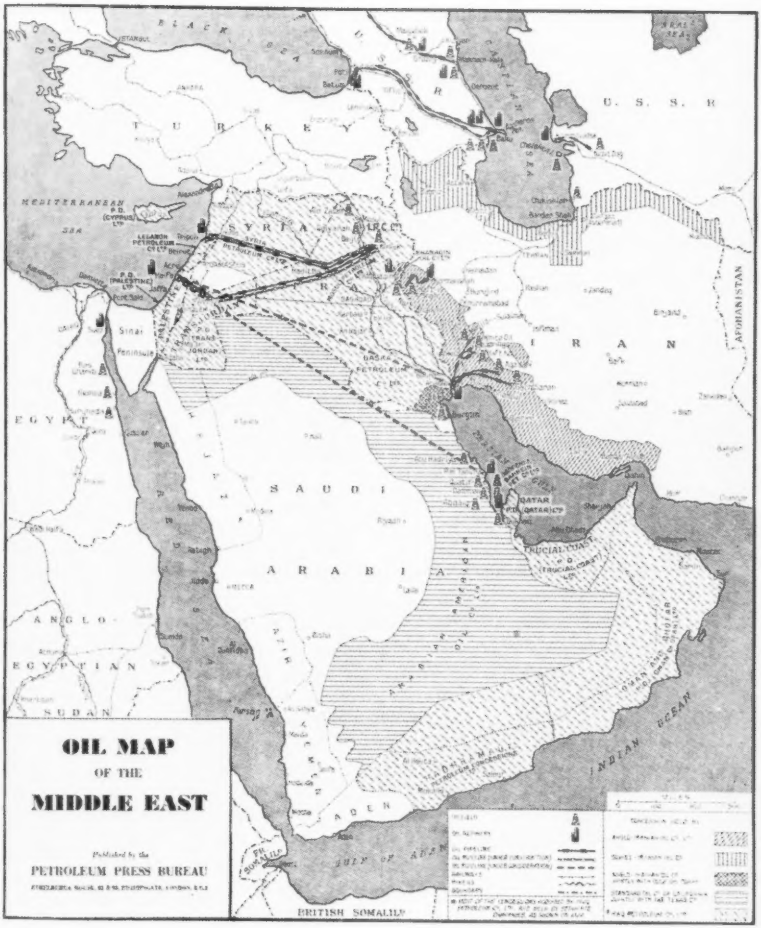
PROPOSED P.R.C. PIPELINE

There was a great deal of opposition within the American petroleum industry to the laying of a government-built pipeline, but it is quite clear that the oil must reach the Mediterranean if it is producible in the quantities anticipated. It is significant, however, in this respect that in the arrangement recently made public, whereby the Anglo-Iranian is going to sell large quantities of crude oil to Socony-Vacuum and to Standard of New Jersey, part of the agreement is the building in common of a pipeline across the Mesopotamian Desert from Abadan to the Mediterranean. At the same time these two American companies are now participating in the Arabian-American company in the development of Saudi Arabia and Bahrein. It may be that feeders to the main pipeline would solve part of the problem. But the second line will almost certainly be built as originally proposed, and as a private venture, not as an American Government project, so that a pipe grid might eventually be visualized.

That the American Petroleum Industry has become "aware" of the Middle East is a logical outcome of the technical report made by the geologist De Golyer to the U.S. Government in 1943 as a result of a technical mission to the Middle East for the purpose of assessing the situation. He said that "The centre of gravity of world oil production is shifting from the Gulf (Caribbean) area to the Middle East-Persian Gulf area and is likely to shift until it is firmly established there."

This and similar statements have continued increasingly to influence the outlook not merely of the American oil industry but of the American public. To such an extent is this true that first of all the P.R.C. projects and now the expansion of the Standard Oil interests may be regarded as their direct conclusions. These conclusions moreover govern almost more than anything else the present trends in the American petroleum world, and have made it Middle East oil-conscious in a way which would have been surprising a year or two back—even long after oil had been struck in Bahrein, or even by the time, quite recently, that cargoes of Arabian crude oil had, in fact, reached the United States.

The potential size of the Middle East fields is best summed up by the De Golyer Mission statement that "when one considers the great discoveries which have resulted from the exploration thus far accomplished in the Middle East, the substantial number of known prospects not yet drilled and the wide areas still practically unexplored, the conclusion is inescapable that reserves of great magnitude remain to be discovered." As a footnote to this is the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TRUCIAL STATES
ANGLO-EGYPTIAN SUDAN
INDIAN OCEAN
ADEN
GULF OF ADEN
BRITISH SOMALILD

Fig. 2.

fact that the whole immense Middle East production is accounted for so far by only some 150 wild-cat wells, whilst over 20 times that number of exploration wells have to be drilled annually in the U.S.A.

So much for the quantitative side of the Middle East. Let us look for a moment at the qualitative aspect of the oil in which the Americans have become so much interested.

The oil of the Middle East—Iranian, Iraqian and Arabian—is generally of a mixed paraffinic-asphaltic base and highly sulphurous. It is well balanced in respect of its light and heavy components and can be processed alternatively to fuel and distillates or, if so wished, by thermal cracking to coke and petrol.

Modern developments in gasoline building largely free this oil from the disability of the low octane rating of its straight-run gasoline. On the other hand, because of its paraffinicity the straight-run gas oil range is particularly valuable for the production of diesel fuels which have high cetane numbers. Finally, investigation and development of recent years have clearly indicated that the Middle East oils are at least good, and are probably a very good, source of high-class lubricating oils.

As a whole, therefore, the oil is a very amenable and highly valuable crude, and it is particularly significant that at present world prices it is very cheap. That is a fact which has, in certain circles in the States, created some alarm in case the introduction of cheap "foreign" oil into the U.S.A. will upset the economic structure of the oil industry.

However, it is very well understandable how the American technologists, after closer inspection, have raised this oil in their estimation from the position of being a sour, questionable, second-rate, intractable product to being one of the high-class and highly potential crudes of the world.

OTHER SOURCES OF OIL

With these prodigious quantities of oil becoming available by direct importation from American concessions or indirectly saving American production by replacing export, it would seem that the United States is playing safe indeed by taking stock of other possible sources of oil and pushing forward with investigations and development for their exploitation. That, however, is what is taking place.

Originally, as a war measure but in effect as a very important peace-time precaution, the U.S. Government, through the Bureau of Mines, formed a Board (described as Research and Development Office on Synthetic and Liquid Fuels) for this purpose. The chief possible sources of oil other than petroleum are:

(*a*) First and foremost coal, in which the States are particularly rich;
(*b*) Natural gas, of which enormous quantities are also available;
(*c*) Oil shale, with which, particularly in Colorado, they are well endowed.

Coal

Schemes have been considered for complete gasification, or hydrogenation of coal and for Fischer-Tropsch synthesis. Although a great deal of data has been accumulated, no substantial steps have been taken for commercial development along these lines; nor, as far as is known, even experimentally along lines dissimilar from those already known with the exception of proposals for complete gasification.

It must be remembered that the coals of America are very largely anthracitic and bituminous in nature, so that German practice in respect of low temperature carbonization and/or hydrogenation of brown coal does not apply. British experience with bituminous coal indicates clearly that as a raw material for hydrogenation it does not compare

in simplicity with the lignites. The same, by the way, applies to so-called "low temperature" distillation which does not compare with the bituminous coking coal treatment developed in Britain. It is probably for these reasons that overt steps have only lately been taken for "turning coal into oil" in the U.S.A. The Fischer-Tropsch synthesis, with coal as a raw material, would doubtless have been progressed with had it not been for the existence of vast pre-existent quantities of methane in the form of natural gas which offers an alternative and more attractive raw material for synthesis. Nevertheless, coal is ultimately going to be the first step, either by way of the producer gas reaction or by making an artificial methane from it. It has been estimated that the suitable coal reserves in the U.S.A. are sufficient to provide, by means of the Fischer-Tropsch reaction, America's oil for at least 1000 years, even at an increasing rate of consumption.

Natural Gas

The U.S.A. is the outstanding source of natural gas in the world, the production representing some 95 per cent of over-all production. The gas consists preponderantly of methane and there is an ultimate reserve of at least 300 billion s.cu.ft. From methane, synthesis gas can be prepared by one of three methods, the choice of method depending on the catalyst chosen and the availability of other gases, e.g., hydrogen. It must be realized in this respect that the higher the ratio of hydrogen the greater the proportion of paraffinic hydrocarbons, whereas a bigger proportion of CO leads to the production of olefines which, for further synthetic purposes, may be of considerable importance.

Most scientific and development work has been done on the steam reaction, but the most theoretically attractive is the process of controlled oxidation. Since this reaction is exothermic and thus does not require expenditure for external heating, the controlled oxidation is technically attractive and should also be better economically, provided sufficiently inexpensive oxygen can be obtained. Using the theoretical two parts of methane to one of oxygen, a mixture of carbon monoxide and hydrogen suitable for use in the standard Fischer-Tropsch reaction without any other treatment than sulphur removal, if necessary, is produced. That is with the exception of the presence of nearly 10 per cent of acetylene which is readily removable and itself can be used as an important raw material for organic syntheses.

The controlled oxidation procedure has been selected to supply synthesis gas for the Carthage-Hydrocol project developed by Hydrocarbon Research Inc. in conjunction with a number of the largest U.S. oil companies directly interested in the utilization of natural gas in the United States. The so-called "Pilot" plant stage for this development was in itself a very big undertaking. The final synthesis is carried out on very similar lines to the conventional Fischer-Tropsch procedure. One of the most interesting features is the production of oxygen which is made on the low-pressure re-cycle system developed by Linde and Frankl, the thermodynamic basis of which is: (*a*) the fractionation of liquefied air (freed, of course, from moisture and CO_2) in a column by a procedure similar to that so widely used at higher temperatures in the petroleum industry; and (*b*) the efficient heat exchange from the expanded nitrogen.

The original compression is only to 100 p.s.i. and an enriched air of 40 to 45 per cent oxygen is first produced. Fractionation of the enriched air in a twin column gives an oxygen of 98 per cent purity. This plant operates for long periods with practically no attention, and gives up to 10,000 s.cu.ft. oxygen hourly as required. Efficiency is almost entirely dependent on the heat exchange and avoidance of heat leakage.

It is claimed for plant of this kind that oxygen can be made for as little as 10*s*. per ton, and at such cost the process in itself is very attractive for important purposes other than the production of synthesis gas. The 10*s*. a ton is even more attractive when based on the gross figure of 5 cents per 1000 cu.ft. which has been quoted. This is because the heat from the exothermic synthesis supplies steam to power the compressors.

As a result of work done at Olean a plant is now in course of erection at Brownsville, Texas, to handle 64,000,000 cu.ft. of natural gas per day. This calls for some 40,000,000 cu.ft. of oxygen.

Perhaps somewhat optimistically the prediction has been made that in a plant of this capacity gasoline can be produced at 5¼ cents per U.S. gallon. This is already distinctly competitive with motor fuel from crude oil and would have to be substantiated. It is admitted, moreover, that capital charges represent about 50 per cent of the costs, raw material being responsible for only 20 per cent. This presumably includes the oxygen as well as the natural gas from which it would appear that the cost of making the oxygen in this particular operation cannot be regarded as critical until the cost of natural gas rises to several times its present price. That, of course, is a thing very likely to happen in the event of the procedure proving a success. The Brownsville plant, on the generally accepted basis of one barrel of gasoline per 11,000 cu.ft. of natural gas, would produce some 6000 barrels of gasoline, which means a capacity of some 1000 tons of crude oil per working day, the estimated total production being 5800 barrels of motor fuel and 1200 barrels of diesel oil.

It is interesting to note that a by-product of the process, consisting of "crude alcohols" in aqueous solution, amounts to some 70 tons daily. These "crude alcohols" contain chiefly acetaldehyde, acetone, and ethyl, propyl, butyl, amyl, and heavier alcohols. Such by-products may prove of considerable value.

It is also interesting to note that P. C. Keith has hazarded the opinion that in the next few years improvements in the process will make it possible to produce a barrel of oil from only 8000 cu. ft. of gas including all that used as fuel.

The significance of all this work and other Fischer-Tropsch developments in the States is great, and no one looking into the matter even casually can but be struck with the enormous reserves of liquid hydrocarbon wealth which may be developed, firstly, from natural gas, and secondly, from coal by its preliminary conversion into a synthetic methane coupled with controlled oxidation by means of cheap oxygen. The magnitude of the conception is impressive and particularly so when viewed in the light of America's direct and vicarious production of petroleum.

Oil Shales

The present reserves of oil shale in the U.S.A. have been estimated by various authorities as approximately 400 thousand million tons, the major part of which is located in deposits in the States of Colorado, Utah and Wyoming. The potential supply of recoverable shale oil in these deposits is of the order of 90 thousand million barrels. The extensive deposits of Colorado give up to 40 U.S. gallons of oil per ton on retorting, and there has been considerable interest stimulated by the Bureau of Mines in the recovery of such oil to support the U.S. in their desire for self-sufficiency.

No extensive modern plants for processing the shale have so far been erected but large-scale pilot plant has been developed and plans made for major commercial operation if need be. Representatives of the Bureau of Mines visited Scotland about two years ago for the purpose of re-acquainting themselves with this home of shale oil but they seemed a little doubtful whether even

modern Scottish plant would be capable of giving the best results with the Colorado shales. One of the reasons for this is that the latter pass through a tumescent stage on heating, which makes their retorting rather difficult.

This interest in oil shale exploitation in the very centre of the world's greatest oil-producing country is highly significant, and it is interesting to note from Table III that oil recovery from shale is by no means the most expensive alternate procedure which has been suggested, nor is the capital investment out of line with the others.

It may be that the underground gasification process for the treatment of shales, which is receiving some practical attention at present in Europe and elsewhere, may reduce the costs and in due course the investment. At present the recovery from the underground "immersion heater" method is poor and the types of deposits suitable for exploitation by this method limited. It should be noted that the only substitute considered likely at present economically to compete with crude oil is natural gas.

None of this, however, excludes the improvement of any of the methods suggested to the point where they can so compete, nor is there any question of their possible strategical importance to the U.S.A. and, for that matter, to other countries similarly situated.

UTILIZATION

Let us now look at the uses to which American oil, however acquired, will be put in light of these two legs of our syllogism and in terms of modifications from existing practice.

1. Lubricating Oils

At present America, and therefore the

Table III*

COMPARISON OF PETROLEUM SUBSTITUTE METHODS

	Raw Materials and Methods					
	Coal		*Natural Gas*	*Oil Shale*	*Tar Sands*	*Crude Oil*
	Hydrogenation	*Synthine process*	*Synthine process*			
Total N. American reserves (billions of tons of source material)	4,000	4,000	>3	>400	>500	?
Percentage of total source reserves most practical for exploitation	26	50–100	10–25	?	1	?
Potential gasoline yield from most exploitable reserves (billions of barrels)	1,000	3,000–6,000	2–4	50	2	10–25
Cost of gasoline (cents per gallon)	15–24	6–18	5–9	8–15	8–12	6–?
Investment (dollars per daily barrel of gasoline)	6,500–13,500	2,800–10,000	2,200–4,770	3,200	1,335–3,300	1,400–2,800

* Weil, B. H., *Refiner*, Nov. 1946, 25 (11), 154

world as a whole, is woefully short of high-grade lubricating oil stocks. This appears to be due to three chief reasons: (1) very much increased consumption; (2) decreased production from the most suitable fields; (3) insufficient lubricating oil refining capacity.

The first is probably due to a combination of unconscious stock-piling after the war and very much higher motor-oil consumption due to the poor condition of the average motor car on the road.

The second will be readily appreciated because of the continued decline of the Pennsylvanian fields and at the same time of the fields—like the Rodessa and East Texas fields—which looked capable by reason of their high paraffinicity, of making up for the reduced Pennsylvanian output. To an appreciable extent this also applies to the Mid-Continent crudes—the main stand-by for solvent-refined lubricating oil residual stocks. There is at present a great scramble for these.

The third is the lack of sufficient double solvent-refining plant or of de-asphaltizing combined with single solvent-refining capacity to deal with the more asphaltic-paraffinic mixed-base crudes which might be exploited.

These reasons will accentuate the tendency to which I previously referred of working-up residuals for lubricants instead of for heavy fuel since it is the cylinder stocks and bright stocks which are most wanted. It is fairly certain too, that the refining will be carried forward to the extent of producing high viscosity solvent bright stocks gradually to replace the high flash cylinder stocks at present regarded as the necessary basis for superheat oils, etc.

As regards the neutrals, there is a growing tendency to use highly refined naphthenic distillates from Gulf Coast "A" crudes and imported Venezuelan and Colombian crudes and distillates, and to combine these materials with synthetic improvers to raise their viscosity index and thereby make up for the insufficiency of natural paraffinic stocks.

That is a very striking feature of the present lubricating oil development in the States and may well lead to the production of oils of very high viscosity index as, and when, mixed base and paraffinic base oils once more become available either from indigenous or exotic crudes.

I should be inclined to forecast, therefore, that any Middle East crudes which are imported directly into the States will, for a time, be utilized by topping to a suitable residue so as to make up for the shortage of heavy fuel strategically demanded. Also that there will be a growing tendency to use these oils themselves as sources of lubricating oil as their value in this respect becomes appreciated.

2. Diesel Oils, Gas Oils, Kerosines

Diesel Electric.—Another very striking trend is the way in which America is becoming high-speed-diesel minded. The inherent efficiency of the diesel and its exploitation for tractive purposes in Europe and, I think we may say, particularly in Britain, have by no means gone unnoticed in the States and the urge to exchange the petrol engine for the diesel for use in transport services is marked.

The advantages of the diesel-electric drive in railway practice are well known, and R. McColl of the American Locomotive Company states that 95 per cent of their present orders are for diesel-electric as against only 20 per cent ten years ago. It is true, however, that there are still only some 3000 diesel-electrics in the U.S.A. but the total number of locomotives on the railways is over 42,000, so that the potential is very high.

Looking at this from the point of view of diesel fuel consumption it is worth noting that tests on 2000 b.h.p. diesel-electrics have indicated consumption of

0.45 lb/b.h.p./hour. From that it is no difficult calculation to see what large quantities of diesel fuel may be diverted to the American railways in the near future. An 8-hour day for only 100 days a year would, for example, represent some 300 tons per locomotive.

Gas Turbines—Jet Propulsion.—It does not seem to be known at present what the position is to be as regards these latest forms of power plant. Gas turbines, driving solely through propeller or through a combination of jet and propeller, can, theoretically, be operated on any form of completely combustible fuel. The kerosine/gas oil ranges seem, therefore, to provide a wide scope of suitable fuel. Against this, however, there is the realization that efficient combustion for this purpose can best be provided from particular oils, thereby limiting the sources from which the fuel may be drawn. For aircraft work too, pour point may be of considerable importance and the combination of combustibility and low temperature behaviour may result in only limited areas or methods of refining being suitable, combined possibly with the use of particular "combustion aids."

It is unlikely that fuels of gasoline type will be reintroduced for such aircraft purposes because of the fire danger. The heavier fuels give to a still greater extent the additional safety which might even to-day be provided by the so-called "safety petrols", i.e., high-flash gasolines suitable only for solid injection engines.

3. Aviation and Motor Fuel

The U.S.A., like other countries, has to give serious consideration to the future requirements of aircraft fuel. There are, of course, two aspects of this question, the first being the one already touched on of the replacement of high octane petrol by jet fuels. But however important this may be, the most important aspect is still the scale of provision of high-octane petrol for the immediate post-war period.

A realistic outlook on the situation can only be based upon an analysis of air traffic and Service requirements. Despite substantial increase in the consumption of petrol by air lines in the two quinquennial periods of 1944/49 and 1949/54, the total quantities which will be required are still not very impressive, nor is the position very much altered by taking into consideration all other branches of civil aviation. It has been estimated that on the most liberal basis civil aviation needs in the U.S.A. will not constitute more than $2\frac{1}{2}$ per cent rising to $4\frac{1}{2}$ per cent in 1954 of their normal motor fuel requirements. To this must be added, however, the substantial quantities of high octane fuels which will be called for by the Services which will remain in being for a long time, or by the export trade in aviation gasoline which is likely to be called for.

The real point, however, is that all such requirements are small compared with the production capacity still existing in the United States for 100-octane fuel as produced during the war. This amounts to over 500,000 barrels daily or 180,000,000 barrels a year—many times that estimated for ten years hence even if all military aircraft were retained on piston-type engines which, of course, is going to be very far from the case.

It appears, therefore, that a great deal of the enormous expenditure in respect of the high octane plants put up during the war, and particularly for catalytic cracking and alkylation, will have to be written off.

There is no hope of absorbing 100-octane gasoline into the motor fuel market since no proper use could be made of it in the existing type of engines. It has been suggested that some twenty years might be necessary before 100-octane gasoline could be commonly used in motor vehicles, by which time design and technological progress are likely

far to have outstripped the present demand for 100-octane fuel, wonderful as it is.

The secondary effects of this probable writing off of the "cat-crack" plants, though of less importance than the main issue, are obviously giving American oil technologists much concern.

One deplorable secondary effect will be the disappearance to a large extent of special by-products, mostly of an aromatic nature, produced in course of "cat-cracking". Such materials showed great promise for the development of new products. They varied in their properties, especially as regards solvent capacity, and chemical stability, according to the number of cracking passes through the plant. Having been through the furnace these materials were essentially very thermo-stable and may not be readily producible by other methods.

4. Synthetic Chemicals

The United States continues increasingly to develop synthetic chemicals from petroleum. There has been no halt in the production of polymers, plastic condensation products, or of aliphatic and aromatic primaries and secondaries as the basis of a petroleum chemical industry and so on. As far as I can make out nothing revolutionary, like Nylon, has been launched or talked about, and the general position is one which has been described very fully on a good many occasions.

I would mention, however, as in the case of the 100-octane plant, that America is faced with the serious decision of whether or not to keep its synthetic rubber plants in operation, and, if so, to what extent. It will be recollected that during the war the States achieved the apparently impossible, not merely by living up to their own objective of 600,000 tons per annum of various types of synthetic rubber but actually providing capacity amounting to nearly 1¼ million tons per annum. How much of this will be required to blend with natural rubber has not yet transpired, but the general feeling is that only a relatively minor proportion will be called for unless the cost of production is substantially reduced or new varieties with still more attractive properties are developed.

ESSO MAGAZINE

We have received the first number of *Esso Magazine*, the new staff magazine issued by the Anglo-American Oil Company. This is a revival of *The Esso*, published by "Anglo" before the war, and is an attractive and highly interesting addition to the staff journals issued by leading oil companies.

Esso Magazine, like its well-known contemporary and associated publication *The Lamp*, besides giving news of matters relating to staff, reports new developments of the issuing company. One such news item is the announcement of the formation of the Esso Development Co., Ltd. (the shareholders in which are the Anglo-American Oil Co., Ltd. and the Standard Oil Development Co.—a Standard of New Jersey subsidiary), to take over, from the beginning of this year, the existing Esso European Laboratories. The new company will work in close co-operation with the Standard Oil Development Co. and will undertake a certain amount of research work of a fundamental character as well as other duties.

Mr H. C. Tett is Managing Director of the new company, and the other Directors are Mr D. A. Shepard, (Chairman of "Anglo" and Standard of New Jersey's representative in London), Mr R. A. Carder (Managing Director of "Anglo"), and Mr Brian Mead (Standard of New Jersey's Refining Co-ordinator for Europe).

TAXATION OF THE PROFITS OF THE OIL INDUSTRY

THE PRINCIPLE OF DEPLETION

By W. H. FELLOWES

THE NEED FOR DEPLETION ALLOWANCES

In most countries the principle is recognized that, in taxing the oil industry and other extractive industries, allowance must be made for the gradual exhaustion of the source of production. The allowance which is granted is called a "depletion allowance". Some countries will not admit the necessity for such an allowance and many only grant it in an inadequate form. It is, therefore, important to show the reasons why adequate allowance for depletion is essential.

It seems no more than elementary common sense that an oil producer should have the right to charge against his income each year an appropriate part of the cost of finding the oil. This cost consists of outlays in acquiring concessions, land, and rights, exploring, surveying and initial drilling. The aim is to provide that, when the oil is finally exhausted, the whole amount originally invested shall, in the course of years, have been allowed in computing tax as an expense against the proceeds from the sale of oil.

The main arguments in support of this procedure are as follows. Whereas a manufacturer buys his raw material as and when he needs it at a cost which he calculates will give him a profit, the oil explorer and producer has to invest very large sums of money in order to obtain reserves of oil in the ground before he can receive one penny from the sale of oil. The oil in the ground is the oil producer's raw material and, though he pays for it by laying out money in development expenses which are, in the main, incurred before any oil can be sold, he has to pay for it as a necessary factor in earning any profit.

Allowances for the cost of finding oil reserves are, moreover, necessary in order to maintain a fair distribution of the tax burden between the oil industry and other trades and industries. It is unfair if the oil producer is refused the right to deduct the cost of his raw material, which is expenditure of a type that the maker of manufactured goods is allowed to deduct as a matter of course.

It is in the interests of an oil-bearing country to make sure that, as established sources of oil decline, new search is made for others to replace them. If the producer is taxed on fictitious profits he is thereby deprived of power to set aside enough money to maintain the exploration work necessary to give a hope of finding new sources to offset the natural decline of the old.

Any refusal to grant annual allowances to write off the cost of obtaining oil reserves tends, therefore, to drive the producer eventually out of business, whereas the admission of such allowances tends to perpetuate a steady flow of revenue into the public treasury.

Even when this type of allowance is, in principle, incorporated in law, in practice there is great danger of its being so modified by administrative regulations as to become almost worthless, because many technical questions may crop up in the detailed calculation, and provision cannot be made in any law for all the possible complications. One particular point, which ought to be made clear in the law or the regulations, is that provision can be made out of

profits from production areas, not only for the recovery of the cost of finding the oil in those particular areas but also of the cost of exploring the unproductive areas. However much expenditure may be spread over a number of different areas the whole is one indivisible investment, and however restricted may be the area where oil may be obtained the oil is the produce from that one indivisible investment.

DEPLETION IN U.S.A. TAX LAW

It is to the United States that we have to look for a lead in the method of taxing oil companies' profits, for not only is the oil industry one of the most important of all industries within its own country, but its output of crude oil amounts to some 65 per cent of the output of the whole world. Furthermore, the fact that there are many thousands of oil operators, many working on a very small scale, ensures that the methods adopted for computing tax liability in the United States are based on experience of a wide range of conditions.

In the United States a depletion allowance was first granted by the Revenue Act of 1913 and was based on the method generally referred to as "Cost Depletion". Under this method it is necessary to establish first the cost of discovery per barrel or ton of the oil to be produced. This is done by the simple formula of dividing the total expenditure on discovery by the total oil reserves discovered as estimated in the light of the available geological evidence. The unit cost so established is then applied to each barrel or ton when produced and sold, exactly as a merchant charges against his income the cost of purchasing the goods sold. The intention was to allow the taxpayer over a period of years to recover his original investment out of the proceeds from sales of oil, but the Revenue Act of 1913 included a provision limiting the amount of the annual allowance to 5 per cent of the gross value of the production. The depletion allowance with such a restriction was practically ineffective and the position was corrected when the 1916 Act granted what was defined as a "reasonable allowance" to be based on full consideration of all technical details.

Soon, however, a new kind of depletion allowance was created as an alternative and the Revenue Act of 1918 is interesting because for the first time an attempt was made to fix a depletion allowance on a basis other than the outlays actually incurred. This was called "Discovery Depletion". What constituted a "discovery" was defined by fixed rules, but the broad effect was that the value of the tract of land could be written up in the light of the new discovery, and depletion allowances could be claimed on the basis of that new value instead of on the actual cost of acquisition. As time went on, however, it was found that the technical details of making a claim for Discovery Depletion involved great complications and an attempt was made to find a simpler method. With this object in view, the authorities instituted an investigation to see whether any relationship existed between the taxpayers' gross income and the discovery depletion allowances so far granted. It was decided that on broad lines a relationship might reasonably be assumed to exist, and from this sprang a new system of depletion which was introduced by the 1926 Act.

This further method is called "Percentage Depletion", and under it the allowance is fixed as a percentage of income and no regard is paid to the cost of acquisition. Following the investigation already mentioned, on the basis of the statistical evidence of discovery depletion allowances actually granted over a period of years, the proportion which the depletion allowance might fairly be assumed to bear to the gross income was fixed at 27½ per cent, and

as a result the existing rule in United States tax law is that for oil and gas wells the allowance is 27½ per cent of the gross income, but there is a limitation that it cannot be greater than 50 per cent of the net income. The taxpayer can, however, claim Cost Depletion in preference to Percentage Depletion in any year if it is more favourable to him. After 1941 the Discovery Depletion, which had been the third alternative up to that year, was discontinued.

MERITS OF DIFFERENT DEPLETION METHODS

A great advantage of the Percentage Depletion method is that it spreads the burden of tax more fairly between different oil producers because within limits it follows their profit-making capacity whereas Cost Depletion is based on expenditure back in the past, the amount of which was influenced by many chances and does not bear any direct relation to the value of the production which resulted from that expenditure.

Furthermore, if the object of depletion is to set aside sufficient money for exploration of new fields to replace the old which are being exhausted, the past expenditures, on which Cost Depletion is based, are no guide for appraising the requirements of future expenditure. That object is more likely to be attained by setting aside a regular percentage of the annual income. If currency fluctuation occurs, the difference in method becomes more marked since Cost Depletion is inflexibly tied to past values whereas Percentage Depletion will annually be in relation to the current value of the product.

From the point of view of the Revenue authorities Percentage Depletion ensures that there will be a payment of tax in all years when there are any operating profits. It also avoids any question of carrying forward losses.

It must not, however, be overlooked that in countries where it is necessary to argue the case for the granting of depletion allowances, Cost Depletion has the advantage of simple logic to support it. As already explained, Percentage Depletion was the result of a gradual development within the United States and is based on conditions peculiar to some extent to that country. The smooth working of the system depends on definition of "gross income" and "net income", and both these terms are capable of the widest construction and even within the United States have led to a maze of legal decisions. Furthermore the percentages used are based on actual experience in that country and there is no way of determining in advance what particular percentages would be appropriate in any other country. The arguments for Percentage Depletion, where they apply, are relatively complicated and likely to be appreciated only where there is a highly developed and experienced tax administration. Elsewhere Percentage Depletion is likely to be misunderstood. In one South American country the tax law allows Cost Depletion, but includes a proviso that the allowance cannot exceed 5 per cent of net income, thus confusing Cost Depletion with Percentage Depletion and granting the benefits of neither.

NO ADEQUATE DEPLETION ALLOWANCE IN THE UNITED KINGDOM

Since the necessity for a depletion allowance is so plain and is so well recognized in American law, it seems strange that there is yet no adequate provision for such an allowance in the law of the United Kingdom. It is true that the Income Tax Act of 1945 has created an allowance on exploration and development expenditure, on a cost depletion basis, but it expressly excludes any costs of acquisition of mineral

rights and, therefore, does not satisfactorily meet the needs of the oil industry.

Yet for nearly a century there has been strong feeling that mining businesses have been bearing more than their fair share of taxation because of the failure of the law to take into account the process of exhaustion of mineral deposits. The Select Committee on the Income Tax in 1851-2 debated the question and the point was made that in the case of lessors of minerals the tax was in many cases levied not on the profit only, but on part of the capital. Again the chairman of the Select Committee of 1861 took the view that "Capital, in the course of realization through the working of mines, is taxed in the assessment of the entire value of their produce."

For a year or two in the late 1870s it looked as if the law did permit a taxpayer to make a deduction from profits to take into account the exhaustion of mineral stocks. In 1877 a judgment was given to that effect in the Exchequer Division of the High Court. It is interesting to note that three judges were sitting in the court and they were unanimous in their opinion. Nevertheless in 1881 this decision was overruled when a similar sort of case was taken to the House of Lords and the point of law was finally settled, though in giving judgment comment was made on the unfair burden laid on the taxpayer.

In the years before the war of 1914 a private member was very active in the House of Commons in attempting to change the law but his efforts failed to make any impression on the Chancellor of the Exchequer. After that war, a Royal Commission on Income Tax sat in 1920 and amongst other things gave a good deal of attention to the question of wasting assets. They found that they were unable to make any general recommendation on the amortization of wasting assets and were of opinion that an allowance should not be granted where the natural resources were within the United Kingdom. They did, however, recommend the granting of an allowance where foreign wasting assets were brought for the first time into the scope of British tax, as for instance when a British company buys from a foreign resident the right to work a foreign mine. Even then they recommended a severe limitation to the allowance because arbitrarily they propounded that in any case the expectation of life of a normal business was thirty-five years and any allowance should be limited to the amount by which an annual payment to replace the capital at the end of a shorter life should exceed the annual payment required for a thirty-five years' life. In the end no action was taken on any of these narrow-minded recommendations.

The position remained unchanged for Income Tax until the Act of 1945, already mentioned. However, in Excess Profits Tax Law a provision was introduced by the Second Finance Act of 1940 which is interesting because it aimed at correcting the injustice, recognizing that, in businesses such as mines and oil wells by reason of their wasting nature, the benefit of capital expenditure is exhausted at a greater rate than in the case of other types of business. The remedy devised was not the granting of an allowance but an increase in the standard profit. Thus the recognition of the principle was by the wording confined to the limited purposes of Excess Profits Tax and did not commit the Treasury to any change for Income Tax. This is an interesting side light on the traditional attitude of the Treasury and throws into relief the change of heart embodied in the Income Tax Act of 1945.

The oil companies have, however, yet to win the right to amortize the cost of acquiring subsoil rights. Not only is the principle sound, but practical consequences must be faced. If companies registered in Britain are going to be subjected to tax on principles which are

unfair to them, one consequence is that there will be a tendency to register oil companies elsewhere in countries taking a more enlightened view of the conditions in which oil companies work.

There is yet another practical reason why the problem must be faced. Since there are now few countries which do not levy substantial income taxes, a common understanding of depletion is important. It seems possible that reciprocal conventions to avoid double taxation may become widespread and, if the arrangements are to work fairly, it is essential that common standards should be used in matters such as this which may affect so greatly not only the burden on the taxpayer, but also the sharing of the revenue between different nations.

UNITED KINGDOM PETROLEUM TRADE IN 1946

By GEORGE SELL, F.Inst.Pet.

PRELIMINARY figures for imports of crude petroleum and refined liquid petroleum products into the United Kingdom during 1946 show that in comparison with 1945 the total decreased by 483,599,000 gallons, or 11·3 per cent. Compared with 1938, the last pre-war year, there was an increase of 602,559,000 gallons (18·8 per cent). Details extracted from the Board of Trade return* are given in Table I, and it will be seen that the decrease in 1946, as compared with 1945, was due to reduced imports of motor and other spirit, counteracted to a considerable extent by imports of crude petroleum being nearly double those for 1945.

Comparing the 1946 figures with those for 1938, there are some increases worthy of note. Thus, kerosine imports were nearly doubled, gas oil imports more than trebled, and fuel oil and diesel oil imports 52 per cent higher than in 1938. On the other hand, imports of motor

TABLE I

U.K. IMPORTS OF PETROLEUM

	1946	1945	1938
		Thousand Gallons	
Crude petroleum	537,266	227,746	567,953
Motor spirit	1,207,987	2,104,806	1,456,667
Other spirit	30,275	46,309	18,097
Kerosine	404,449	342,054	206,362
Lubricating oil	89,078	77,324	108,198
Gas oil	492,503	482,016	157,926
Fuel oil and diesel oil	1,044,505	1,009,408	687,346
Other sorts	1	—	956
Total	3,806,064	4,289,663	3,203,505
		Cwt.	
Paraffin wax	667,313	667,425	809,749
Mineral jelly	128,559	155,136	136,378
		Tons	
Natural asphalt and bitumen	26,927	10,312	79,164
Manufactured bituminous asphalts and emulsions	463	416	52,055

* Accounts relating to Trade and Navigation of the United Kingdom, December, 1946. H.M.S.O., 4s. 6d.

TABLE II

U.K. RE-EXPORTS OF IMPORTED PETROLEUM

	1946	1945	1938
		Thousand Gallons	
Motor spirit	44,573	16,114	14,075
Kerosine	5,426	2,510	2,832
Lubricating oil	6,175	1,837	4,344
Fuel oil and diesel oil	3,921	13,104	4,284
All other sorts	8,503	5,672	3,596
Total	68,598	39,237	29,131

spirit in 1946 were 17·1 per cent less than in 1938, and crude petroleum and lubricating oil were also lower.

Total c.i.f. value of liquid petroleum imports, crude and refined, in 1946 was £86,851,037, a reduction of 40·3 per cent in comparison with the 1945 value of £145,616,980, but nearly double the £45,980,197 value of the 1938 imports. Of this total in 1946 the value of crude petroleum was £9,669,460, an increase of 84·6 per cent over the 1945 value of £5,238,640 (£5,177,532 in 1938).

Although total imports of refined liquid petroleum products were 19·5 per cent less in quantity in 1946 than in 1945 the corresponding decrease in value was 45 per cent, i.e. from £140,378,340 in 1945 to £77,181,577 in 1946.

Solid and semi-solid products imported in 1946 were not vastly different in quantity from 1945, but the imports of natural asphalt and bitumen were more than doubled.

RE-EXPORTS

Re-exports of imported petroleum products in 1946 were 74·8 per cent higher than in 1945 and more than double those in 1938, as shown in Table II. Total value of these re-exports was £2,516,913 in 1946, £1,456,336 in 1945, and £800,496 in 1938.

The total quantities of fuel oil shipped for the use of steamers, etc., engaged in the foreign trade, including fishing vessels, was 402,283,000 gallons in 1946, 415,852,000 gallons in 1945, and 313,204,000 gallons in 1938.

EXPORTS

Details of exports of petroleum products produced and manufactured

TABLE III

U.K. EXPORTS OF HOME PRODUCED AND MANUFACTURED PETROLEUM

	1946	1945	1938
		Thousand Gallons	
Motor spirit	1,882	484	54,982
Kerosine	136	16	12,114
Lubricating oil	32,194	3,992	17,466
Gas oil	2,190	—	29,129
Fuel oil and diesel oil	343	243	17,200
All other sorts	2,515	358	2,790
Total	39,260	5,093	133,681
		Cwt.	
Lubricating compounds	110,644	11,351	605,265
Paraffin wax	11,546	18,666	88,016
		Tons	
Manufactured bituminous asphalts and emulsions	109,813	24,486	91,928

TABLE IV. COUNTRIES CONSIGNING PETROLEUM TO THE U.K.

Country and Product	1946	1945	1938
		Thousand Gallons	
British West Indies:			
Motor spirit	101,221	22,608	90,607
Kerosine	93,296	40,899	—
Fuel and diesel oils	56,391	24,503	118,136
	250,903	88,010	208,743
Canada:			
Motor spirit	—	31,974	—
Other British:			
Crude petroleum	14	2	20,390
Motor spirit	46,836	4,130	8,022
Kerosine	8,884	3,294	2,854
Lubricating oil	259	11	79
Gas oil	13,001	7,939	12,039
Fuel and diesel oil	9,665	5,913	1,197
	78,659	21,289	44,581
Dutch West Indies:			
Crude petroleum	228,485	148,473	160,782
Motor spirit	332,836	208,531	589,531
Kerosine	93,292	65,016	50,892
Gas oil	72,988	23,357	21,936
Fuel and diesel oil	512, 044	339,429	251,290
	1,239,645	784,806	1,074,431
United States:			
Crude petroleum	45,035	62,463	14,995
Motor spirit	386,282	1,802,335	314,497
Kerosine	116,820	221,823	57,800
Lubricating oil	63,298	71,120	85,660
Gas oil	349,317	430,676	39,404
Fuel and diesel oil	104,687	622,313	63,312
	1,065,439	3,210,730	575,668
Iran:			
Crude petroleum	80,998	5,796	54,221
Motor spirit	303,413	26,766	314,066
Kerosine	85,213	11,022	59,884
Gas oil	13,132	11,872	37,093
Fuel and diesel oil	327,909	729	161,365
	810,665	56,185	626,629
Venezuela:			
Crude petroleum	139,985	10,891	138,975
Peru:			
Crude petroleum	15,049	—	21,865
Iraq:			
Crude petroleum	7	7	141,796
Soviet Union:			
Motor spirit	—	—	47,460
Lubricating oil	—	—	13,360
			60,820
Dutch E. Indies:			
Motor spirit	—	—	23,854
Other Foreign:			
Crude petroleum	27,693	114	14,929
Motor spirit	37,399	8,462	68,630
Kerosine	6,944	—	34,932
Lubricating oil	25,521	6,193	9,099
Gas oil	44,065	8,172	47,454
Fuel and diesel oil	33,809	16,521	92,046
	175,431	39,462	267,090

in the United Kingdom are given in Table III and show that, while the 1946 total is nearly eight times that of 1945, it was only 29·4 per cent of the 1938 total. Comparing 1946, the first post-war year, with 1938, the only increased export is for lubricating oil, and of the total of 32,194,000 gallons, 75·3 per cent or 23,252,000 gallons were exported to foreign countries as against 9,325,000 gallons or 53·4 per cent in 1938.

Total value of liquid petroleum products exported in 1946 was £3,808,182, or nearly ten times the 1945 value of £406,033 and, in spite of the decreased quantity noted above, 33·4 per cent higher than the 1938 total value of £2,853,937.

Consigning Countries

Some information as to countries from which U.K. imports are consigned are given in the official return, but such countries are not necessarily the place of origin of the shipments.

The information which is available in regard to petroleum and its products is set out in Table IV and shows that consignments from British countries represented 8·7 per cent of the total imports in 1946, compared with 3·3 per cent in 1945 and 7·9 per cent in 1938.

In regard to consignments from foreign countries it is of interest to note that while the United States provided 74·8 per cent of the imports in 1945, the percentage in 1946 had dropped to 28 per cent, all grades of products being lower in quantity than in the previous year. The corresponding figure for 1938 was 18 per cent. All other foreign countries which are recorded as having exported oil to the U.K. in 1946 increased their deliveries over the 1945 figures, the largest increases being for Iran and Venezuela.

INTERNATIONAL GEOLOGICAL CONGRESS

The Eighteenth Session of the International Geological Congress, which was to have been held in Great Britain in 1940, has now been arranged to be held in London from August 25 to September 1, 1948. President designate of the Eighteenth Session of the Congress and President of the Organizing Committee is Sir Thomas H. Holland, K.C.S.I., D.L., LLD., F.R.S., a past-president of the Institute of Petroleum.

The subjects provisionally selected for consideration are:

1. Problems of Geochemistry.
2. Metasomatic Processes in Metamorphism.
3. Rhythm in Sedimentation.
4. The Geological Results of Applied Geophysics.
5. The Geology of Iron-Ore Deposits.
6. The Geology of Petroleum.
7. The Geology, Paragenesis and Reserves of the Ores of Lead and Zinc.
8. The Geology of Sea and Ocean Floors.
9. The Pliocene-Pleistocene Boundary.
10. Faunal and Floral Facies and Zonal Correlation.
11. The Correlation of Continental Vertebrate-Bearing Rocks.
12. Earth Movements and Organic Evolution.

Details are obtainable from the General Secretaries, Eighteenth Session International Geological Congress, Geological Survey and Museum, Exhibition Road, South Kensington, London, S.W.7.

NORTHERN BRANCH DINNER DANCE

A COMPANY of over 100, comprising members of the Northern Branch of the Institute of Petroleum and their friends, attended a happy and successful dinner dance at the Midland Hotel, Manchester, on Friday, February 28.

The dinner guests were received by Mr G. H. Thornley, Chairman of the Northern Branch, and his sister, Mrs Dale, who was presented with a bouquet from members of the Northern Branch.

Among those present were the Lord Mayor, Alderman T. H. Adams, J.P., the Chairman of Council, Mr G. H. Coxon, accompanied by Mrs Coxon, the Chairman of the Branches Committee, Mr J. A. Oriel, and Mrs Oriel, and the Honorary Secretary of the Institute, Mr Chilvers, and Mrs Chilvers. There were also representatives of the other Branches.

The Lord Mayor, proposing the toast of "The Institute of Petroleum" after dinner, referred in genial vein to the popular belief that Lord Mayors had neither brains nor knowledge but claimed that in his case he had at least some knowledge of petroleum affairs, since it had been his job, during hostilities, to move hundreds of tons of petrol, in connexion with supplies to the armies in France, through the pipeline system that was constructed for the purpose, although his end of the affair was connected with the railways. He emphasized the importance of petrol in the present fuel crisis and wished every success to the Institute.

Mr. G. H. Coxon, who replied on behalf of the Institute, thanked the Lord Mayor, but pleaded that the part which could be played by petroleum should not be over-emphasized to the extent that we should ever forget that we are a coal country, and that we stand or fall by how well we handle our coal problems. In the general way petroleum ought not to be a substitute for coal as a boiler fuel. The petroleum industry does not give people crude oil to burn. It uses science and presents users with carefully prepared finished products, and the time will come when the coal industry may look at its raw material in the same way. He thought also there were lessons to be learned from the way the petroleum industry had pooled its knowledge during the war.

In this dissemination of knowledge and information the Institute had played its part and there was much work to be done in keeping the young technicians in the industry posted as to what was going on. The new journal, entitled *Institute of Petroleum Review*, would fulfil this function and the Institute of Petroleum as a body was conscious of its responsibilities towards the industry in setting forth the necessary technical data on which quality and specifications of products could be judged by the buyer as well as the seller.

Mr Thornley, Chairman of the Northern Branch, then proposed the toast of "The Guests". He expressed his regret at the unavoidable absence of Sir Andrew Agnew, but explained that the coincidence of Sir Andrew's birthday falling on that day had given prior claim to his presence in his domestic circle. In extending a welcome to all the guests, Mr Thornley said he wished to mention specially the Lord Mayor, Mr Coxon, Mr Oriel and Mr Chilvers, as well as all the representatives of other Branches who had managed to be present. He was afraid that the austerity of these times precluded the kind of feast which might have rendered them incoherently happy, but within permissible limits they were doing their best as a Branch to give the guests a good time and he hoped that all guests were having, and would continue to have, a very pleasant evening.

Mr J. A. Oriel, on behalf of the guests assembled, made a cordial and happy

response. In a skilful speech he tabulated the ameliorations of what he would otherwise have regarded as the arduous task of speaking in public, even to respond to such a vote of thanks as this. These were that, as guests, they were warm (climate nearer, in fact, than they had been for weeks to the future temperature to which some of them could look forward), they were well fed (and that without any scandal-provoking breach of regulations, which might have embarrassed the Lord Mayor), and crowning joy, they would not have to wash up (a task which even the combined ingenuity of science and petroleum technologists had not yet succeeded in making pleasant or even interesting). Most of all they were grateful for the hospitality which could be depended upon from the Manchester Branch. The mere mention of a "do" at Manchester evokes an immediate resolution to be there, hail, rain or snow; and all three had done their worst, but still there they were! He found the Northern Branch the most boisterous and unruly of all, but they had, nevertheless, warm hearts and a generous nature, best proof of which was perhaps the fact that one could forget he was an official guest in being made welcome as one of the family.

After the dinner a very pleasant dance was held until the small hours and for a time at least thoughts of crisis, or even of petroleum, were banished and all guests will certainly agree in saying "Well done, Manchester!"

COUNCIL COMMENTARY

SEVENTEEN members of Council assembled on March 12 under the Chairmanship of Mr Coxon, regrets for absence being received from eleven others.

The Agenda covered reports from Branches, Election, Finance, and Publications Committees, together with miscellaneous items concerning accommodation, the Empire Mining & Metallurgical Congress, the next World Petroleum Congress, and the Report of Council for 1946.

On behalf of Branches Committee Mr G. H. Thornley, deputizing for Mr J. A. Oriel, reported on the recent meeting of the Branches Committee in Manchester and stated that draft rules were being prepared for submission to Council in connexion with the proposed London Branch of the Institute. This Branch would differ from a standard Branch, even of the student type, but would supply a genuine want not at present catered for at all.

The Branches Committee nominations for *ex officio* Members of Council by virtue of office in Branches were also submitted.

The Election Committee made recommendations dealing with candidates, five for Fellowship, three for transfer to Fellowship, eight for Membership, fourteen for Associate Membership and twelve for Student Membership, also two students for transfer to Associate Membership.

Following some discussion on a border-line case, it was recommended that in certain cases the Election Committee should, if need be, interview candidates in addition to receiving the usual papers.

The Finance Committee drew attention to rising expenditure, which already was certain to exceed income for the coming year and recommended a careful survey of the working of the Institute to ensure efficiency. The report of the Council for 1946, which had been circulated, was discussed and it was agreed to have it edited and distributed in stencilled form at the Annual General Meeting.

A small Committee was formed to make final arrangements for the Cadman Memorial Lecture meeting, including the invitation list, which required rather special care.

It was reported that Mr R. P. Russell had agreed to give a series of lectures to Branches and that arrangements for these were already in hand.

The pressing matter of future accommodation was reported on and further steps decided.

It was decided to ask the Publications Committee to have three papers prepared for the Empire Mining and Metallurgical Congress.

Major Cadman drew attention to a proposal to celebrate the Centenary of Mr James Young in 1948. Prof. Garner was asked to see what part we could play in this celebration.

Colonel Auld reported a meeting between Mr Coxon, himself, the Honorary Secretary and Colonel Pineau, dealing with proposals for the Third World Petroleum Congress now overdue. It was agreed to discuss this more fully in London in July during the International Congress for Pure & Applied Chemistry, when it should be possible to get representation from various countries.

Council accepted with genuine regret the resignation of Mr C. W. Wood and many tributes were paid by members to his long service and his scrupulous observance in his Press capacity of the confidence of the Institute.

Mr Coxon indicated his desire to retire from the Chairmanship of Council this year, in order to initiate an alternation of retirement between Presidents and Chairmen.

Education in Petroleum

For this month these notes deal with the Education Committee.

Two objects of the Institute are as follows:

(1) *To establish a hall-mark of proficiency.*

(2) *To promote the better education and training of persons engaged in or intending to engage in the petroleum or allied industries and if thought fit to hold examinations, award certificates, diplomas, prizes or scholarships and to adopt any lawful means conducive to the setting up of a high standard of professional conduct among those employed in such industries.*

The various grades of membership are intended to fulfil the object (1) and award of this hall-mark rests with the Election Committee who, in the absence of agreed standards of a definite character, have an unenviable task.

Late in 1945 an Ad Hoc Committee was appointed with the particular object of devising means of assisting the Selection Committee and, later in early 1946, an Education Committee was formed which set itself the task of inaugurating suitable technical courses leading to examinations, upon the result of which a qualification in Petroleum Technology acceptable to the Institute as part qualification for Associate Fellowship could be based.

A broad summary was prepared on what the petroleum portion should be and the extent and character of auxiliary education which should be demanded. It was recognized from the outset that it would be difficult and probably inadvisable to force every new entrant through one gate, and that many existing and recognized qualifications, e.g., degrees in science or engineering, membership of the Royal Institute of Chemistry or the Institution of Chemical Engineers required only a supplementary experience of several years in the industry to constitute satisfactory qualifications for membership of the Institute of Petroleum on the technological side. It was soon equally obvious that the real gap in the network

of educational routes leading to qualification lay before the student who, having attained his matriculation or equivalent, could not proceed to the University and, having already joined the industry, could study only part-time. In the past many such entrants to the industry had eventually arrived at the highest positions but had nothing to show as evidence of their competence except their position in the industry.

It was soon realized that the devising and undertaking of examinations is no light matter to be tackled casually by amateurs, and early contact with the City and Guilds of London Institute, who already carry out examinations, elicited sympathetic co-operation and action. The City and Guilds Institute decided to set up an Advisory Committee for Petroleum and Petroleum Products, allocating four places to the Institute of Petroleum Council, and under this Advisory Committee to appoint a special Syllabus Sub-committee, on which we hold the Chairmanship and one other place. This Sub-committee held seven meetings in 1946 and early in 1947 reported back to the main Advisory Committee with a view to getting the new courses and examinations under way for 1949.

Courses have been devised to be held at suitable technical colleges available for students of school-leaving standard, leading finally to examinations, success in which gains the award of a full technological certificate of the City and Guilds Institute in Petroleum Technology. Such courses will entail part-time and day-release attendance spread over five or more years and will cover Chemistry, Physics, Mathematics and Engineering Drawing as auxiliaries to Petroleum Science and Technology, and will indeed confer a fairly balanced education of a technological character. Candidates, nevertheless, will be permitted, if desirous, to attend only the courses in Petroleum Technology, thus catering for those of junior rank who do not wish to pursue a complete and balanced course of education. Certificates obtained for such limited courses will not, of course, be acceptable to the Institute of Petroleum as qualification unless there is other evidence that the desired standard of general education has been achieved.

As yet only the Intermediate Stages of courses and syllabuses have been fully worked out in detail, but it is expected to complete the whole series within the year.

So far, so good! But there is the viewpoint that this is just one more of the interminable series of courses and examinations with which the young student is presented on the threshold of his industrial career. It ought to be possible by co-operative effort between various societies and examining bodies to devise courses, syllabuses and examinations which would deal with common ground and be available to students taking chemical engineering subjects as part of the complete examination for the various societies, such as the Institute of Fuel, Institute of Petroleum, and so on.

Discussion has taken place since before the war, but a recent meeting of a committee called together by the City and Guilds appointed a new committee on which we are represented, consisting partly of industrial and partly of academic interests, to see whether definite recommendations cannot be made in conjunction with the Board of Education to devise such courses and examinations as will simplify the existing system and make possible a general foundation examination in chemical technology which will be acceptable to all the various bodies at some stage.

The alternate aim should be that examinations and qualifications of this type should be recognized as steps towards the highest awards, whether such be membership of the Royal Institute of Chemistry, the Institute of

Chemical Engineering, the Institute of Petroleum or the proposed Bachelorship in Technology, so that there should be open a recognized road along which a student can travel at any age to the achievement of the highest qualifications which shall have recognition as such throughout the industrial and academic world. This is perhaps an ambitious project, but it is a very real need.

There remains one other aspect of this whole question. Owing to the very widely scattered geographical domain of the oil industry there will always be some unfortunates who find themselves at the ends of the earth before they have by any means completed what they themselves would regard as their technological education. How are they to acquire further qualifications? By very great effort it is possible to obtain external degrees in Universities such as London, but it is not possible everywhere to set up technical schools as in our cities and towns and, even in this country, it is not always easy for a man to follow his occupation, particularly after the apprenticeship stage, and at the same time be able to put in day or evening attendance as needed at recognized institutions. As a result of this kind of demand, there are correspondence colleges in existence, but these are not officially recognized in the educational set-up and, in general, are not of equivalent standing to the type of examination we have visualized in these notes. We have, therefore, in due course to consider to what extent we, as an Institute, can devise at least courses of reading, if not actual correspondence courses, so that no one is left out from this attempt to provide facilities and hall-marks for those who have it in them to pursue their studies and their vocation side by side.

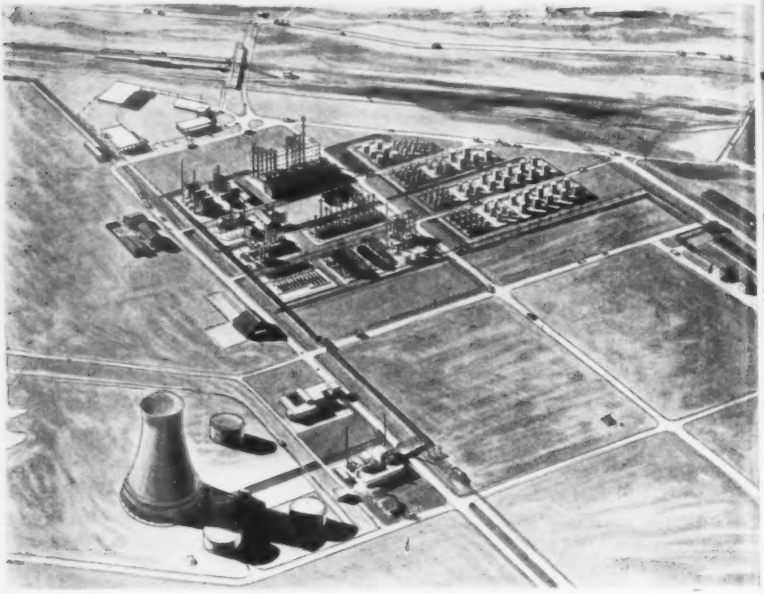
CHEMICALS FROM PETROLEUM

AN IMPORTANT NEW BRITISH INDUSTRY

News of a valuable new industry for Great Britain was given to the Press in a recent announcement by the Shell Petroleum Co., Ltd., of extensive plans for the production of chemicals from petroleum. Heretofore the chemical industry in this country has had to rely upon two main sources for its raw material, namely coal (with its by-products) and molasses. The introduction of a third major source, petroleum, has a significance which will be readily realized by readers of the *I.P. Review*.

Manufacture of chemicals from petroleum first commenced in Britain during the war, when a large plant was added to the Shell refinery at Stanlow to produce synthetic soaps which previously had been supplied almost entirely by Germany. This plant, stated to be the only one of its kind in the world, was originally designed for an output of 12,000 tons per annum of the sodium higher alkyl sulphate range of synthetic detergents (synthetic soaps and cleansing agents) and wetting agents for industrial and domestic use. So great is the present and potential demand for these products that additional plant is under construction to give an annual production of 50,000 tons of synthetic detergents by the middle of next year. Incidentally, by providing an alternative to ordinary soaps, these products will help to relieve the shortage of fats which enter so largely into soap manufacture.

A second extensive Shell plant, also to be ready early in 1948, is under construction at Thornton-le-Moors, Cheshire, for the production of a wide range of organic chemicals. The initial production



Aerial perspective drawing of the new Thornton Plant

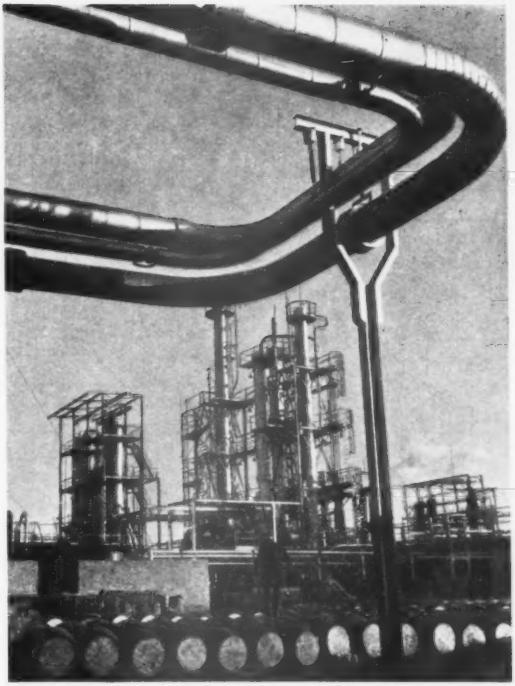
will comprise a large number of chemical solvents, the most important of which will be *iso*propyl alcohol, acetone, methyl *iso*butyl ketone, secondary butyl alcohol and methyl ethyl ketone. These chemicals are in demand by the pharmaceutical and other industries for the extraction of drugs and essential oils, the organic synthesis of drugs and other chemicals, as emulsifiers, as carriers in perfumes, lotions and nail varnishes, and as base materials for shampoos and creams.

The Shell Haven refinery of the company, which manufactures insecticides, fungicides and other products used in agriculture, is also being enlarged and will eventually produce 30,000 tons of these products per year. This will be of the greatest value to agriculture and horticulture in view of the vital necessity to increase the country's home production of foods. The products include soil fumigants, sprays for fruit, and insecticides for live stock. Supplementing the work at Shell Haven, the study of plant life, pests and diseases, and improved methods of applying insecticides will be carried out at an experimental farm of 170 acres which Shell have acquired at Woodstock, Kent.

Among other potential users of the chemical products from the plants at Thornton, Stanlow, and Shell Haven are the engineering industry, for such purposes as acid pickling, aqueous cleaning and degreasing, and electroplating; the leather and fur industries, for soaking liquors and degreasing; the paint industry, for solvents, as a base material for such products as lacquers, varnishes, resins, driers, and preservatives for ropes, canvas, and wood; the plastics industry, as base materials or

solvents for coatings, resins, phenols, and laminates; the rubber industry, for processing and compounding and preparation of coatings and adhesives; and the textiles industry for rayon manufacture, fabric coating and waterproofing.

With the present serious adverse balance of trade with America and the urgent necessity for restricting dollar payments it is not the least important feature of the new industry that all the petroleum to be used as raw material will be imported from sterling countries. Furthermore the output from the new plant at Thornton will partly replace imports from the United States, and it is estimated, will thereby save dollar expenditure of about £4,000,000 per year. Owing to its modern character and to the use of the most up-to-date processes and automatic methods of control, the operation of the new chemical plant will make only a small demand upon man-power: about 200 workers and staff will be employed. The value of output per employee will be among the highest in Britain's basic industries.



Teepol Plant, Stanlow, near Chester

ELECTION OF INSTITUTE OFFICERS

Sir Andrew Agnew, C.B.E., has been re-elected President of the Institute for the 1947–48 Session. H. C. Tett has been elected a Vice-President and the following Vice-Presidents have been re-elected: G. H. Coxon, E. A. Evans, A. C. Hartley, J. S. Jackson, and J. A. Oriel.

A. T. Beazley, F. Morten, and H. de Wilde, have been elected Members of Council and the following have been appointed *ex-officio* Members of Council as Branch representatives: H. A. Ruffell and A. J. Featherstone (Northern Branch), W. R. Guy (Scottish), R. B. Southall (S. Wales), and V. Biske and H. E. F. Pracy (Stanlow).

G. H. Coxon has been elected Honorary Treasurer and G. Chilvers as Honorary Secretary.

U.K. PETROLEUM CONSUMPTION

Total quantity of hydrocarbon oils imported into the United Kingdom and entered for home consumption on payment of customs duty during 1946 was 17·5 per cent lower than in 1945, but an increase of 5·8 per cent over the 1938 total. Compared with 1938 the official figures,* summarized in the accompanying table, show that in 1946 the quantity of motor spirit retained for home consumption was 12·1 per cent lower, while road fuel oil, kerosine, and gas oil were 65·2, 72·4 and 308·3 per cent higher respectively.

	Million Gallons		
Light oils:	1946	1945	1938
Motor spirit	1,185·5	1,799·2	1,348·4
Other sorts	41·9	40·2	34·0
Heavy oils:			
Road fuel oil	142·4	118·6	86·2
Other fuel oil	142·8	85·8	293·8
Kerosine	356·0	347·1	206·5
Lubricating oil	139·9	145·1	129·9
Gas oil	290·1	251·7	71·3
Other heavy oils	4·1	2·5	6·4
Total	2,302·7	2,790·2	2,176·5

*"Accounts Relating to Trade and Navigation of the United Kingdom", January 1947.

SCOTTISH BRANCH

In spite of the severe weather conditions, accentuated by a heavy snowfall, over forty members of the Branch were present for the fourth meeting of the present session, presided over by Mr R. Crichton and held on February 28 in the North British Station Hotel, when Mr J. Idris Jones, M.Sc., F.R.I.C., delivered his lecture: "Some Impressions of the German Coal Tar Industry", illustrated by lantern slides.

The usual discussion after the lecture did not take place, owing to the lateness of the hour and the fact that many of those present had to face somewhat long homeward journeys over difficult roads.

Over eighty members and guests from the Scottish Branches of the Royal Aeronautical Society, the Institution of Automobile Engineers, the Institution of Mechanical Engineers, and the engineering students' societies of the Glasgow University and Royal Technical College, were present at the fifth meeting on March 28. Air Commodore F. Rodwell Banks, C.B., O.B.E., F.Inst.Pet., delivered an address on "Engines for Aviation—The Future" and an interesting discussion ensued.

CHANGE OF NAME

Barrett, Tagant and Gotts, Ltd., of Fulham and Manchester, have changed their trading name to Maxima Lubricants Ltd.

PERSONAL NOTES

The death occurred in London on February 15 of *Sir Louis Kershaw*, K.C.S.I., C.I.E., a Director of the Burmah Oil Co. Ltd., and formerly Deputy Under-Secretary of State at the India Office.

Dr Alexander King, formerly Senior Lecturer, Royal College of Science and, since 1944, head of the United Kingdom Scientific Mission in Washington and Scientific Attache at the British Embassy there, has joined the Board of the Dee Oil Co., Ltd., of Liverpool. In 1938, while on the staff of the Royal College of Science, Dr King headed a scientific expedition to Jan Mayen in

the Arctic. During the early years of the war he worked successively for the War Office and the Ministry of Supply—where he became Assistant Director of Scientific Research—and later transferred to the Ministry of Production as Assistant Scientific Adviser to the Minister.

H. N. Bassett, A.M.I.Mech.E., F.Inst. Pet., has resigned his post as chief chemist of the Buenos Aires Great Southern & Buenos Aires Great Western Railways on appointment as head of Technical Division of Shell-Mex (Argentina) Ltd.

William M. Stratford, formerly Vice-President of Texaco Development Corporation, has been elected its President in succession to *R. J. Dearborn*, who has retired after twenty-seven years' service with Texaco Development and its parent, the Texas Oil Company.

Max S. App has been appointed Vice-President and Director of Production of the General Petroleum Corporation to succeed *B. E. Parsons*, who retired in January after thirty-three years with General Petroleum.

J. Howard Pew has resigned the presidency of the Sun Oil Co., after thirty-five years in office, but is continuing as a director. He is succeeded as president by *Robert G. Dunlop*, comptroller of the company, which he joined in 1933 after two years with a firm of accountants. *Joseph N. Pew, Jr.*, executive vice-president, has been chosen for the newly created post of chairman of the board of Sun Oil, with which company he has been associated since 1908. He is also chairman of the board of the subsidiary Sun Shipbuilding and Dry Dock Co. *Arthur E. Pew, Jr.*, has resigned as vice-president of Sun Oil in charge of manufacturing, but is continuing as a member of the board.

Burt E. Hull has been elected a vice-president of The Texas Co., which he joined in 1905 as a junior engineer. For the past twenty-one years he has been president of the subsidiary Texas Pipe Line Co., but he resigned that post, in which he is being succeeded by *Ralph B. McLaughlin*, who has been vice-president and manager of the Pipe Line Co. since 1943. Mr Hull, during the war, served as vice-president and general manager of War Emergency Pipe Lines Inc., supervising the construction of the "Big Inch" and "Little Big Inch" pipelines in the U.S.A., and is now on leave of absence to serve as president of the Trans-Arabian Pipe Line Co., in which capacity he will supervise construction of the 1,050-mile pipeline from Saudi Arabia to the Mediterranean.

E. H. Wellmeyer, assistant manager of Cities Service Oil Co. (Pa.), has been appointed vice-president of the company. He started with Cities Service in 1923 and is also a director of Cities Service Refining Corporation.

A. C. Long, formerly associated with foreign operations of The Texas Co., has been elected a vice-president of California Texas Oil Co. Ltd., a subsidiary of Texaco and Standard Oil of California. He will have charge of Caltex marketing operations west of Suez and particularly in Britain, Eire, on the continent of Europe, and in North Africa.

FORTHCOMING MEETINGS

INSTITUTE MEETINGS

The Development of Hydrogenation and Fischer-Tropsch Processes in Germany. Major Kenneth Gordon. At 26, Portland Place, London, W.1. 5 p.m. May 7.

The Use of Petroleum Products in the Printing Ink and Allied Industries. Dr A. C. Healey and Dr L. Ivanovszky. At 26, Portland Place, London, W.1. 5 p.m. June 11.

NORTHERN BRANCH

Annual General Meeting. At Engineers' Club, Albert Square, Manchester. 6 p.m. May 20.

MEETINGS OF OTHER SOCIETIES

The Re-Use of Waste Liquors in Industrial Processes. B. A. Southgate. Institution of Chemical Engineers, London. At Geological Society, Burlington House. 5.30 p.m. May 6.

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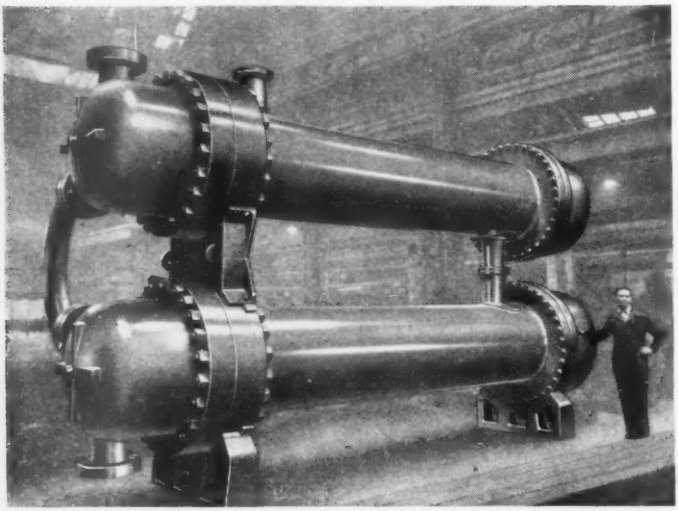

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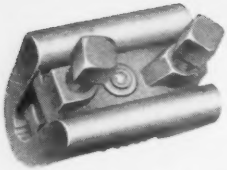

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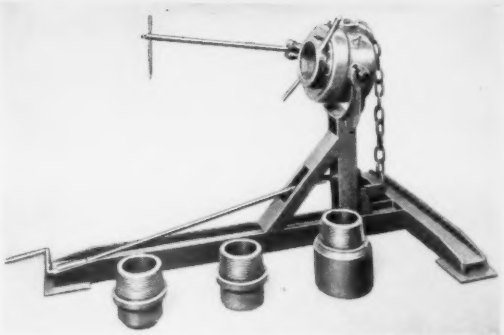

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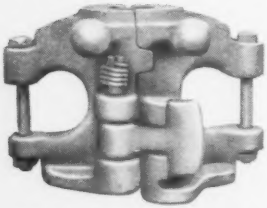

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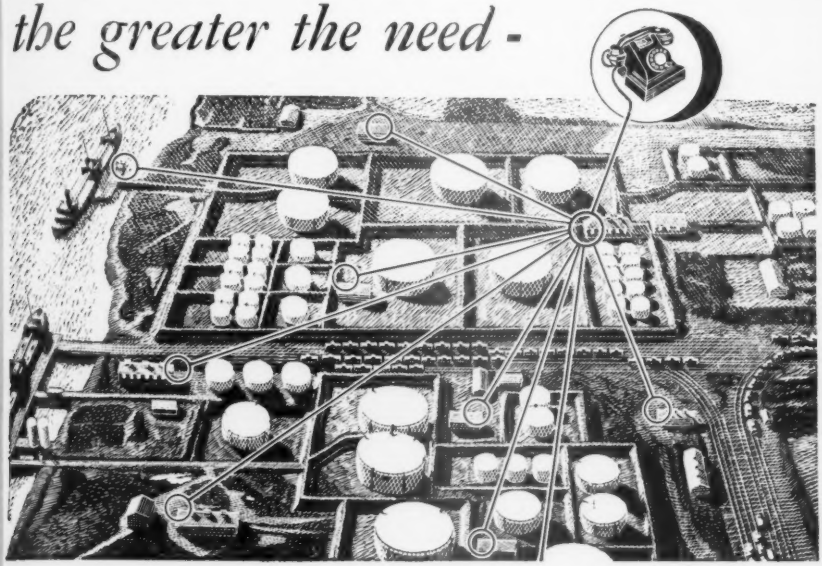

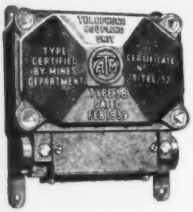

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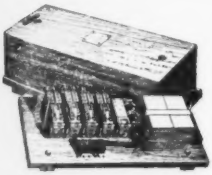

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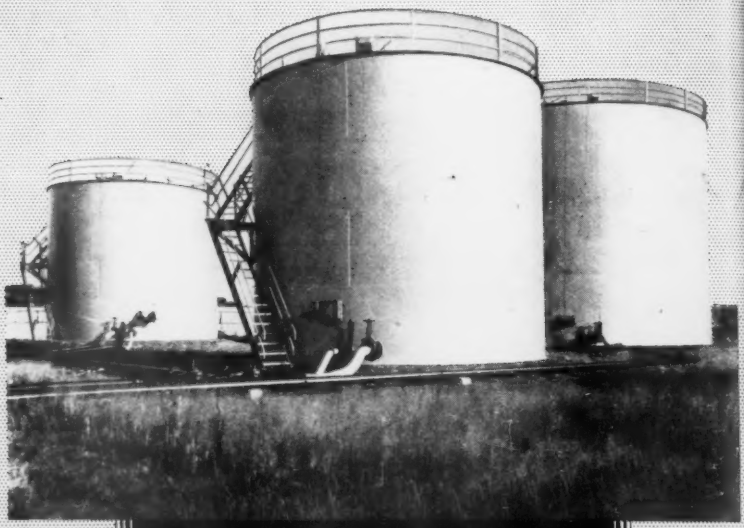

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